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Part 11 in a series about inshore fish of Hawaii. The 12-part series is a project of the **Hawaii Fisheries Local Action Strategy**.

SAY WHAT? FISH TALK COULD HELP MONITOR REEF HEALTH

BY SCOTT RADWAY

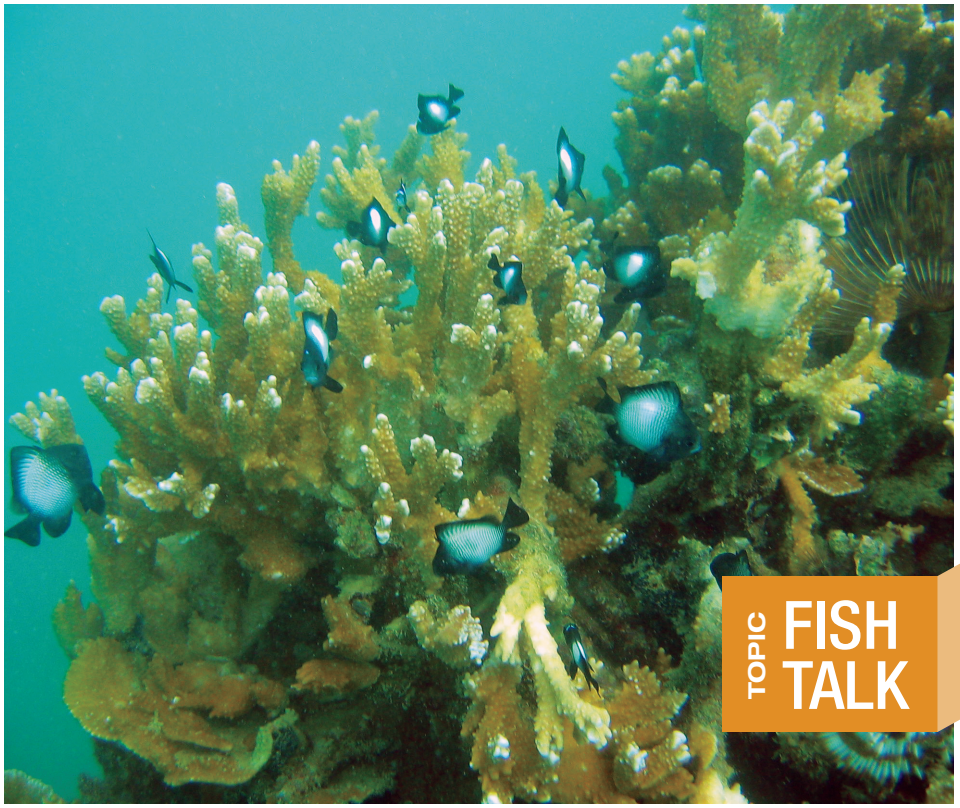

Photo: Aran Mooney

Male domino damsel fish will swim up into the water column and make a chirp-like noise, likely to attract a female.

THERE IT WAS ON HIGH-SPEED FILM: Each time the forceps butterflyfish retracted its rear fin a sound was emitted. "That same fish, when it raises its head, it can produce a single pulse sound," says Kelly Boyle, a PhD candidate at the University of Hawaii who has spent countless hours reviewing fish film.

Why? The fish is using sound to communicate. While our ears might not be tuned to hear the low frequency underwater sounds fish emit, fish are using sound to do such things as establish a territory, to attract a mate or to spawn more successfully. Call it fish talk. And in recent years, marine scientists like Boyle are increasingly trying to understand, with high-speed underwater cameras and microphones, what fish are saying.

For example, Aran Mooney, a UH graduate student who recently completed his PhD, says a male domino damsel fish will swim up into the water column and make a chirp-like noise, likely to attract a female. "Sound is one of the better ways of communicating in the water," Mooney says. But he adds that while much attention has been paid to how marine mammals such as dolphins and whales use sound, how fish use sound is much less known.

To put it in perspective, Tim Tricas, professor of Zoology at UH Manoa and Hawaii Institute of Marine Biology, notes that there are more than 25,000 species of fish in the world. Of that, only about 1,000 have been studied for sound production and many more species need to be investigated. Of that 1,000, there are only a few that we actually know what the fish sound is used for.

In Hawaii, there are more than 1,200 species of fish but less than a handful have had scientific papers published on sound communication. "There is a lot of acoustic information produced on the reef by many, many species that we don't know a thing about," Tricas says. But Tricas believes that by deciphering those sounds scientists and resource managers can potentially take a huge step forward in their ability to monitor the health of reef ecosystems over long periods of time.

Tricas explains that by understanding which sounds are associated with which fish and what behaviors, you should be able to predict what activity was taking place on a reef by analyzing a sound recording. For example, you could tell if a type of fish was in an area, if it was spawning and when. Then, over time you could tell whether the numbers of that fish were increasing or decreasing by tracking the number of sounds the fish makes.

Can You Hear Me Now?

Fish hear very differently from us. That's because a fish's inner ear works on small calcified 'stones' called otoliths that are six times more dense than the fish body. So when sound travels through water, the majority of the fish's body actually moves in unison with the sound wave, as the body is the same density as the water. But the more dense otoliths move slower, and tiny hairs in the fish's ear pick up on the difference. "Like marbles in a tin can," says marine biologist Kelly Boyle.

Some fish, such as the butterflyfish, also have tiny hornlike structures on their air bladders that extend up near to the ear. When a sound wave hits them they push on the ear and make it about 10 times more sensitive to sound. Some fish also have special muscles around their air bladder that they can use to create a sound. Imagine the muscle as a drumstick and the bladder as a drum.

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Once scientists record reef sounds, how do they decipher what fish are saying?

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But to do that kind of analysis, scientists would need long-term sound recordings from shallow coral reefs. That's where the Ecological Acoustic Recorder, or EAR, comes in. It's a device that can be placed on a reef and set to record over a year or more, normally for a few minutes each hour, every hour of every day. The instrument was developed by a group of Hawaii scientists and has already been deployed in oceans around the world, says Marc Lammers, of the National Oceanic and Atmospheric Administration, one of the creators of the EAR.

Some of the locations include four in the Northwestern Hawaiian Islands and another four in American Samoa. There are also EARs deployed throughout the Pacific Islands, and in Alaska, Californian, the Mediterranean, and even off Iceland. "It's a versatile tool that can go lots of places and listen for a variety of things," says Lammers. "With state-of-the-art technology, we are able to observe the marine environment in ways that we haven't been able to before."

And that's 24-7.

Lammers says they are building a library of recordings with the intention of having a database that stretches over years. The next critical step is learning to interpret the sounds and for that, Tricas is on the leading edge. Starting with a grant from Hawaii Undersea Research Laboratory, Tricas and Boyle are recording long-term EAR sounds, and also fish video and sounds off of the Kona coast to start building an acoustic dictionary of sorts for reef fish.

"The key is to know which species is making what sound," Tricas says.

As each sound is deciphered and linked with a fish species it can be used to translate the data that Lammers' and Tricas' EARs have collected using advanced computer analysis software. Tricas adds the long-term EAR recordings can also result in research trips when scientists identify an unknown fish sound that occurs at a site on specific days each year. They could then send a dive team to document the fish and its activities that are associated with the sounds.

"This project is so new we don't know what is going to come out of it. There are just so many opportunities with these new technologies," Tricas says.

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Photos: Tim Tricas

An Ecological Acoustic Recorder, or EAR, used for long-term monitoring of reefs.

QUIET, PLEASE

To record fish sounds on video, scientists used specialized equipment that can both record sound and video underwater. They also need to be able to breathe quietly underwater. One problem in the past is that traditional scuba diving creates a lot of bubbles as divers exhale and that noise is picked up by the hydrophone.

To get around that, Tim Tricas, professor of Zoology at the University of Hawaii and Hawaii Institute of Marine Biology, and his graduate student, Kelly Boyle, have been trained on high-tech devices called rebreathers. The devices are self-contained systems that allow a diver to breath air in a loop. The carbon dioxide exhaled is removed by a scrubber and then a computer replaces the used oxygen. So there are no bubbles and virtually no sound.

Rebreathers are complicated to operate and require specialized training. In fact, Tricas says UH is one of the few universities that support rebreather training and research. UH is in unchartered territory in when it comes to Tricas' robust cataloging of reef fish sounds. "To my knowledge we are the only lab in the world currently using these technologies to address reef fish population sounds," Tricas says.